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PROPOSED REGISTRATION DECISION

Carboquat 250T

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OVERVIEW

Proposed Registration Decision for Carboquat 250T

Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the *Pest Control Products Act*[1] and Regulations, is proposing full registration for the sale and use of active ingredient Carboquat 250T and end-use product Carboquat WP-50 as a heavy duty wood preservative for wood destined for non-industrial above-ground and ground contact uses.

An evaluation of available scientific information found that, under the approved conditions of use, the product has value and does not present an unacceptable risk to human health or the environment.

This overview describes the key points of the evaluation, while the Science Evaluation section provides detailed technical information on human health, environmental and value assessment of Carboquat 250T and Carboquat WP-50.

What Does Health Canada Consider When Making a Registration Decision?

The key objective of the *Pest Control Products Act* is to prevent unacceptable risks[2] to people and the environment from the use of pest control products. Health or environmental risk is considered acceptable if there is reasonable certainty that no harm to human health, future generations or the environment will result from use or exposure to the product under its conditions or proposed conditions of registration. The Act also requires that products have value[3] when used according to the label directions. Conditions of registration may include special precautionary measures on the product label to further reduce risk.

To reach its decisions, the PMRA applies modern, rigorous risk-assessment methods and policies. These methods consider the unique characteristics of sensitive subpopulations in humans (e.g. children) as well as organisms in the environment (e.g. those most sensitive to environmental contaminants). These methods and policies also consider the nature of the effects observed and the uncertainties present when predicting the impact of pesticides. For more information on how the PMRA regulates pesticides, the assessment process and risk-reduction programs, please visit the PMRA's website at www.pmra-arla.gc.ca.

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1 As per subsection 28(1) of the *Pest Control Products Act*.

2 "Acceptable risks" as defined by subsection 2(2) of the *Pest Control Products Act*.

3 "Value" as defined by subsection 2(1) of the *Pest Control Products Act*: "...the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's (a) efficacy; (b) effect on host organisms in connection with which it is intended to be used; and (c) health, safety and environmental benefits and social and economic impact".

What Is Carboquat 250T?

Carboquat 250T is a broad-spectrum biocide with a carbon-based chemistry. It is to be mixed with a registered copper-based biocide to create a wood preservative. Wood is pressure treated with this preservative to control fungal decay and prolong the service life of the wood. The wood products treated with the Carboquat 250T-copper mixture are intended for residential applications that are not in contact with water.

❖ Health Considerations

♦ Can Approved Uses of Carboquat 250T Affect Human Health?

Carboquat 250T is unlikely to affect your health when used according to the proposed label directions.

People could be exposed to Carboquat 250T when handling and applying the product, and also if contact is made with treated wood surfaces. When assessing health risks, the PMRA considers two key factors: the levels where no health effects occur and the levels to which people may be exposed. The dose levels used to assess risks are established to protect the most sensitive human population (e.g. children and nursing mothers). Only the uses for which the exposure is well below levels that cause no effects in animal testing are considered acceptable for registration.

Toxicology studies in laboratory animals describe potential health effects from varying levels of exposure to a chemical and identify the dose at which no effects are observed. The health effects noted in animals occur at doses more than 100-times higher than levels to which humans are normally exposed when products containing Carboquat 250T are used according to the label directions.

Both Carboquat 250T and Carboquat WP-50 are of high toxicity when given as a single oral dose to rats and are extremely irritating to the skin of rabbits. Consequently, the statements "Danger—Poison" and "Corrosive to Eyes and Skin" are required on the product labels.

When assessing the toxicity of Carboquat 250T in animals receiving daily doses over longer periods of time, the PMRA considered it appropriate to use animal studies performed with another structurally related chemical (didecyl didemethyl ammonium chloride; DDAC). The health effects following exposure to DDAC are considered to be representative of Carboquat 250T.

DDAC did not cause cancer in animals and was not genotoxic[4]. There was also no indication that DDAC would cause damage to the nervous system or adversely affect reproduction. The first signs of toxicity in animals given daily doses of DDAC over longer periods of time were clinical signs of toxicity in the animals, most likely a result of the irritating properties of the chemical, and subsequent decreases in body weight. The risk assessment protects against these effects by ensuring that the level of human exposure is well below the lowest dose at which these effects occurred in animal tests.

When DDAC was given to pregnant animals, effects on the developing fetus were only observed at doses that were higher than that which cause adverse effects in the mother. This indicates that the fetus is not more sensitive to DDAC than the adult animal. Consequently, no extra protective measures were applied during the Carboquat 250T risk assessment.

- **Risks in Residential and Other Non-Occupational Environments**

Estimated risk for non-occupational exposure is not of concern provided that directions specified on the label are observed.

A risk assessment conducted for individuals contacting structures constructed with treated wood indicated that risk for adults and children is not of concern when the product is used according to the label directions.

- **Occupational Risks From Handling Carboquat WP-50**

Occupational risks are not of concern when Carboquat WP-50 is used according to the proposed label directions, which include protective measures.

Workers mixing, loading or applying Carboquat WP-50 as well as workers handling freshly treated wood can come in direct contact with Carboquat 250T on the skin or through inhalation of spray mists. Therefore, the label will specify that anyone mixing or loading Carboquat WP-50 or exposed to the treatment solution or freshly treated wood must wear face protection, chemical-resistant coveralls over a long-sleeved shirt and long pants, chemical-resistant gloves, chemical-resistant footwear and respiratory protection. Based on these label requirements, risk to workers pressure treating wood is not a concern.

For bystanders, the exposure is expected to be much less than that of workers and is considered negligible. Therefore, health risks to bystanders are not of concern.

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[4] Genotoxic chemicals are those capable of causing damage to DNA. Such damage can potentially lead to the formation of a malignant tumor, but DNA damage does not lead inevitably to the creation of cancerous cells.

❖ Environmental Considerations

♦ What Happens When Carboquat 250T Is Introduced Into the Environment?

Carboquat 250T is unlikely to affect the environment when used according to the proposed label directions.

Carboquat 250T is persistent in soil and water/sediment systems. It is stable to hydrolysis, phototransformation and biotransformation and does not form any major transformation products in the environment. It strongly binds to soils; therefore, it has a low potential to leach into groundwater and contaminate it.

As Carboquat 250T partitions into sediment, binds strongly and is persistent, it has a high potential to pose a risk to sediment dwelling organisms. If surface runoff water from stacked treated wood in open lumber yards and effluents from treatment plants enter into aquatic systems, Carboquat 250T will pose a risk to aquatic organisms. Risk is mitigated by precautionary label statements limiting exposure of Carboquat 250T to aquatic systems. As well, wood treated with this product is not to be used in water.

❖ Value Considerations

♦ What Is the Value of Carboquat 250T and the End-Use Product Carboquat WP-50 ?

Carboquat WP-50 is a heavy duty wood preservative component that is to be mixed with one of two copper ethanolamine end products (NW 100-C or ACQ C2-EU) for the pressure treatment of wood intended for above ground and ground contact uses.

Carboquat WP-50, when tank-mixed in a 1:2 ratio with either NW 100-C or ACQ C2-EU and used to treat wood in a pressure cylinder, provides an effective protection against decay fungi and augments the service life of the wood. Wood treated with this preservative combination is intended for non-industrial uses where the treated wood will be above-ground and in contact with the ground. Carboquat WP-50 combined with either NW 100-C or ACQ C2-EU forms a preservative very similar to the currently registered ACQ-type wood preservatives. The main difference between this preservative and the currently registered preservatives is that it is expected to result in a less corrosive treating solution, which is less damaging to the metal cylinder and treating plant equipment.

Measures to Minimize Risk

Labels of registered pesticide products include specific instructions for use. Directions include risk-reduction measures to protect human and environmental health. These directions must be followed by law.

The key risk-reduction measures being proposed on the label of Carboquat WP-50 to address the potential risks identified in this assessment are as follows:

Key Risk-Reduction Measures

- **Human Health**

  Because there is a concern with users coming into direct contact with Carboquat 250T on the skin or through inhalation of spray mists, anyone handling Carboquat WP-50 or freshly treated wood must wear face protection, chemical-resistant coveralls over long-sleeved shirt and long pants, chemical-resistant gloves, chemical-resistant footwear and respiratory protection.

- **Environment**

  Limiting exposure of Carboquat 250T to aquatic systems through direct discharge or surface runoff from stored treated wood in lumber yards will minimize the risk to all aquatic organisms. As well, wood treated with this product is not to be used in water.

Next Steps

Before making a final registration decision on Carboquat 250T, the PMRA will consider all comments received from the public in response to this Consultation Document[5]. The PMRA will then publish a Registration Decision document[6] on Carboquat 250T, which will include the decision, the reasons for it, a summary of comments received on the proposed final registration decision and the Agency's response to these comments.

Other Information

At the time the PMRA makes its registration decision, it will publish a Registration Decision document on Carboquat 250T (based on the Science Evaluation section of this Consultation Document). In addition, the test data referenced in this Consultation Document will be available for public inspection, upon application, in the PMRA's Reading Room (located in Ottawa).

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5 "Consultation statement" as required by subsection 28(2) of the *Pest Control Products Act*.

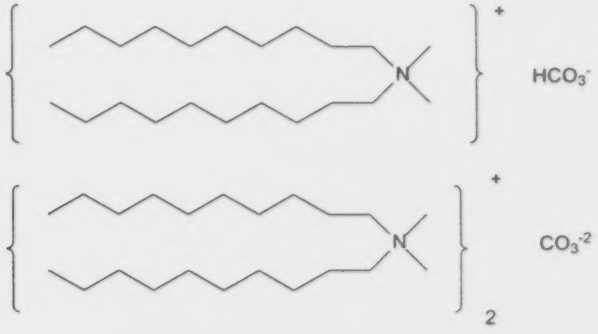
6 "Decision statement" as required by subsection 28(5) of the *Pest Control Products Act*.

SCIENCE EVALUATION

Carboquat 250T

1.0 The Active Ingredient, Its Properties and Uses

1.1 Identity of the Active Ingredient

Active substance	mix of didecyldimethylammonium carbonate and didecyldimethylammonium bicarbonate
Function	wood preservative
Chemical name	
1. International Union of Pure and Applied Chemistry (IUPAC)	N-decyl-N,N-dimethyl-1,1-decanaminium carbonate and N-decyl-N,N-dimethyl-1,1-decanaminium bicarbonate
2. Chemical Abstracts Service (CAS)	didecyldimethylammonium carbonate and didecyldimethylammonium bicarbonate
CAS number	148788-55-0 and 148812-65-1
Molecular formula	$C_{45}H_{96}N_2O_3$ and $C_{23}H_{49}NO_3$
Molecular weight	712 and 387
Structural formulas	
Purity of the active ingredient	43.0% quat, present as the salts

1.2 Physical and Chemical Properties of the Active Ingredients and End-Use Product

Technical Product—Carboquat 250T

Property	Result
Colour and physical state	Clear yellow liquid
Odour	Faint amine odour
Boiling point	Similar to water
Specific gravity	0.9646
Vapour pressure	N/A as the compound is ionic
Henry's law constant at 20°C	Very soluble in water
Ultraviolet (UV)-visible spectrum	Not expected to absorb at $\lambda > 300$ nm
Solubility in water at 20°C	Completely miscible
Solubility in organic solvents	Soluble in octanol
n-Octanol-water partition coefficient (K_{ow})	N/A as the compound is ionic
Dissociation constant (pK_a)	N/A as the compound is ionic
Stability (temperature, metal)	Stable to elevated temperatures, metals and sunlight

End-Use Product—Carboquat WP-50

Property	Result
Colour	Clear yellow
Odour	Faint amine odour
Physical state	Liquid
Formulation type	Solution
Guarantee	43.0% quat, present as the salts
Container material and description	20 L to bulk tanker
Specific gravity	0.9646
pH of 10% dispersion in water	8.8
Oxidizing or reducing action	Does not contain oxidizing or reducing agents
Storage stability	Stable for 12 months
Explodability	Not expected to be explosive

1.3 Directions for Use

Carboquat WP-50 is one component of a heavy duty wood preservative that is to be mixed with a registered copper ethanolamine end-product (either NW 100-C or ACQ C2-EU) in a 2:1 ratio of CuO to Carboquat. This preservative mixture is applied to wood through pressure treatment. The resulting treated wood is to be used in non-industrial above-ground and ground contact uses such as residential decks, patios, fencing, framing, and poles. The treated wood is not for aquatic uses and cannot be used for critical infrastructures such as bridges or utility poles. The relevant parameters for treatment are supported by data (Table 1.3.1).

Table 1.3.1 Treatment rates as supported by data

End Use	Target Retention rate (kg/m^3)
Above Ground – Non-Structural	4
Above Ground – Structural	6.4
Ground Contact	6.4

1.4 Mode of Action

Carboquat WP-50 is a 50% solution of didecyldimethyl ammonium carbonate/bicarbonate. The cationic portion of this quaternary ammonium compound acts as a surfactant and kills microbes by disrupting cell membranes. The contribution of the anion (e.g. carbonate, bicarbonate, or chloride) is negligible and the biological activity of Carboquat WP-50 (DDA-carbonate) was shown to be similar to that of didecyldimethylammonium chloride (DDAC).

2.0 Methods of Analysis

2.1 Methods for Analysis of the Active Ingredient

The methods provided for the analysis of the active ingredient and the impurities in technical Carboquat 250T have been assessed to be acceptable for the purposes of this application.

2.2 Method for Formulation Analysis

The method provided for the analysis of the active ingredient in the formulation has been assessed to be acceptable for the purposes of this application.

2.3 Methods for Residue Analysis

High-performance liquid chromatography methods with tandem mass spectrometry (HPLC-MS/MS) were developed and proposed for data generation and enforcement purposes. These methods fulfilled the requirements with regards to selectivity, accuracy and precision at the

respective method limits of quantitation. Acceptable recoveries were obtained in fish tissue, soil, sediment and water matrices.

3.0 Impact on Human and Animal Health

3.1 Toxicology Summary

Although acute toxicity data were submitted for Carboquat 250T, a bridging rationale was provided (and determined to be acceptable) to use the metabolism and repeat-dose studies conducted with didecyl dimethyl ammonium chloride (DDAC) in support of Carboquat 250T. The only structural difference between DDAC and Carboquat 250T is the counter ion. The counter ion for DDAC is the negatively charged chloride ion, whereas the counter ion for Carboquat 250T is a mixture of the negatively charged carbonate and bicarbonate ions. This difference in chemical structure is not expected to influence the toxicity of the compound.

Available data indicated that after oral administration of DDAC to the rat, the primary route of excretion was the feces (89-99%), indicating little absorption. Both sexes excreted low doses by 38 hours and high doses by 72 hours. Female rats appeared to have a more extensive metabolism of DDAC than males. Total tissue residues were very low (0.003 - 0.675%), indicating little deposition of the test article. Four metabolites were apparent, primarily stemming from the oxidative modification of the decyl side chain.

Carboquat 250T is of high acute toxicity by the oral route of exposure (LD_{50} =245 mg/kg bw). Waiver requests were accepted for the acute dermal, acute inhalation and eye irritation studies based on the corrosiveness of the test substance. Carboquat 250T is extremely irritating to the skin of New Zealand White rabbits, but was not a dermal sensitizer in Hartley albino guinea pigs.

Results from subchronic and long-term oral toxicology studies indicate that DDAC does not elicit any specific target organ toxicity. Carboquat 250T is a quaternary ammonium compound, and as such the most prominent effects observed in the database reflect the highly irritating nature associated with this class of chemicals. Generalized toxicity was observed in rats, mice and dogs as decreases in body weight and body weight gain. Clinical signs of toxicity apparent at higher dose levels in the rat and mouse, including emaciation and hunched posture, were likely related to the corrosive nature of the test compound. Dogs appeared to be more sensitive to exposure to DDAC with an increase in emesis and soft feces observed at doses $\geq$10 mg/kg bw/day. An increase in audible/ laboured respiration was noted in the teratology studies in both rats and rabbits.

Mortality occurred at higher doses (3000 ppm) in the 90-day dietary studies in mice and rats, as well as in the developmental toxicity study in rabbits (at 10 mg/kg bw/day). These mortalities likely reflect the corrosive nature of the test substance.

In a 90-day dermal study in rats, no systemic effects were noted at doses up to12 mg/kg bw/day. No dermal NOAEL could be established in this study because of severe irritation noted at all dose levels. A special (non-guideline) 21-day dermal irritation study in rats was conducted with

Carboquat WP-50 for the purpose of evaluating dermal irritation and providing results in the same units as those used to report human exposure ($\mu g/cm^2$). The NOAEL for dermal irritation in this study was determined to be 10 $\mu g/cm^2$.

No evidence of carcinogenic potential was observed in the oncogenicity studies conducted with DDAC in the rat or the mouse. A consistent effect noted at high doses in both species was a decrease in body weight and/or body-weight gain. At the high dose in the rat, histiocytosis, blood in the sinuses, and an increase in hemosiderosis of the mesenteric lymph node were also noted. The dose levels chosen for these studies were deemed adequate based on the observed clinical effects. In addition, DDAC was determined to be non-genotoxic in both *in vitro* and *in vivo* mutagenitic studies.

There is no evidence of teratogenicity or effects on reproductive parameters in the DDAC toxicity database, nor is there any evidence of increased susceptibility of the young. Therefore, additional safety factors for the protection of children and pregnant females from relevant endpoints of concern, or any database uncertainty regarding a potential for increased sensitivity in these population subgroups, were not warranted.

Results of the acute and chronic tests conducted on laboratory animals with Carboquat 250T and its associated end-use product Carboquat WP-50 are summarized in Tables 1 and 2 of Appendix I.

3.2 Determination of Acceptable Daily Intake

An acceptable daily intake was not established since there are no proposed food uses for Carboquat 250T.

3.3 Determination of Acute Reference Dose

An acute reference dose was not established since there are no proposed food uses for Carboquat 250T.

3.4 Occupational and Bystander Risk Assessment

3.4.1 Toxicological Endpoints

Occupational exposure to Carboquat 250T is characterized as intermittent long-term in duration and is predominately by the dermal route.

Intermediate-term dermal

The most appropriate toxicological endpoint for the intermediate-term dermal risk assessment is the NOAEL in excess of 12 mg/kg bw/day (the highest dose tested) from the 90-day dermal study in rats. The target MOE is 100 (10X for interspecies variation and 10X for intraspecies variation). This study is of the appropriate route and duration. There were no signs of systemic toxicity up to and including this dose level, whereas severe skin irritation, including ulceration, was observed.

Intermediate-term oral

The NOAEL of 37.5 mg/kg bw/day from the rat reproduction study was considered to be the most appropriate for use in the intermediate-term oral risk assessment. The target MOE is 100 (10X for interspecies variation, and 10X for intraspecies variation).

The NOAEL of 3 mg/kg bw/day from the one-year dog study was also considered for this scenario. The rat reproduction study, however, was determined to be a more appropriate choice for endpoint selection in light of the duration of the study, the route of administration (dietary versus bolus gavage), and the fact that the effects observed in the dog study (emesis) are reflective of the corrosive nature of the test material.

Long-term dermal

The most appropriate toxicology endpoint for the long-term dermal risk assessment is the NOAEL of 12 mg/kg bw/day from the 90-day dermal study in rats. The target MOE is 100 (10X for interspecies variation and 10X for intraspecies variation).

This study is of the appropriate route of administration, and since irritation is the primary effect noted after repeated dermal dosing, it is unlikely that dosing over a longer interval would produce a significantly different result than that noted in the 90-day study.

Dermal Absorption

In support of this submission, the applicant submitted a study entitled "The *In Vitro* Percutaneous Absorption of [^{14}C]-Didecyldimethylammonium Chloride (DDAC) Through Human Skin". Given the limitations of *in vitro* methodology in predicting *in vivo* dermal absorption, together with the corrosive nature of Carboquat 250T, it was considered appropriate to use a dermal absorption default of 100% in the exposure assessment.

3.4.2 Occupational Exposure and Risk

There is potential for workers handling Carboquat WP-50 and treated wood to be exposed to the active ingredient via the dermal and inhalation routes while mixing and loading the product via a closed system as well as while carrying out tasks involving contact with freshly treated wood. As wood can be treated all year round, the duration of exposure is expected to be long-term.

To estimate exposure to workers in heavy duty wood treatment facilities, data from a surrogate study where exposure to CCA was measured at three treatment facilities was used (Bookbinder, 2001). This study was considered appropriate for use as a surrogate for workers exposed to Carboquat WP-50 since the tasks performed and treatment methods are similar for both products.

This study was designed to quantify potential exposure to chromate copper arsenate type C (CCA-C) products and ammoniacal copper zinc arsenate (ACZA) products during high pressure treatment of wood in commercial treatment facilities. Dermal exposure was monitored using whole body dosimetry (WBD), and glove dosimeters. Inhalation exposure was monitored using personal air sampling pumps and filters. Exposure to the head and neck were not monitored.

The study was conducted at three sites: Orangeburg, SC, Guelph, ON, and Eugene, OR. CCA-C was used at two sites and ACZA was used at one site. Eight job functions representing Treatment Operator (n=15), Treatment Assistant (n=10), Loader Operator (n=15), Supervisor (n=5), Test Borer (n=5), Tram setter (n=5), Stacker Operator (n=4), and Tally Man (n=5) were monitored during the study. This equates to 64 replicates. Although the job functions were assigned a specific title, the tasks performed by each employee varied at different sites. Employees were monitored for a typical workday (approximately 8 hours). Workers wore fresh work uniforms over whole body dosimeters consisting of a cotton long-sleeved work shirt and cotton work trousers, or a one-piece cotton coverall. At one site, additional shirts or jackets were provided as per typical practice. Some workers wore protective gloves over glove dosimeters.

For each WBD segment, glove pair and filter, the measured result was corrected using the mean field recovery value from the most appropriate spike level for the specific site and day of sampling. Field recovery corrections were applied only when recovery was <95%.

For the purposes of this exposure assessment, the arithmetic mean total exposure to all oxides was estimated for each replicate. The target retention rate for CCA and ACZA in the study ranged from 2.86 to 5.54 kg/m^3 and the guarantee of oxides in CCA is 60%. The exposure estimates from the CCA study were normalized to the concentration of active ingredient in the diluted solution of Carboquat WP-50 (i.e. the maximum proposed treatment solution concentration is 3.4% active ingredient).

It was considered appropriate to use the overall average exposure across all job functions since different tasks were performed by different workers at each site. At a 3.4% treatment solution concentration, the overall mean dermal exposure estimate, 0.148 mg/kg bw/day, results in an MOE which achieves the target (100). This risk estimate is considered conservative as the NOAEL of ≥12 mg/kg bw/day is the maximum dose used in the study and no systemic effects were observed.

Inhalation MOEs were not calculated as inhalation exposure is a minor route of exposure and no route-specific toxicology endpoints were identified. Due to the corrosive nature of the product, all workers with the potential for inhalation exposure to Carboquat WP-50 are required to wear respiratory protection.

3.4.3 Residential Exposure and Risk

3.4.3.1 Handler Exposure and Risk

There are no domestic class products; therefore, a residential handler assessment was not required.

3.4.3.2 Postapplication Exposure and Risk

Individuals (adults and children) have potential for exposure to the active ingredient when contacting structures constructed with treated wood. Two studies (one on sapwood and one on heartwood) were submitted by the registrant which measured transferable Carboquat 250T residues from pressure treated wood.

The studies were designed to collect data to estimate transferable residues for Carboquat 250T on treated sapwood or heartwood boards treated with ammoniacal copper quat (ACQ), which is a mixture of Carboquat WP-50 and a copper formulation, at a commercial pressure treating facility. The studies were conducted in Guelph, Ontario. Transferable residues were sampled using dry polyester wipes beginning 8 days after the boards had been treated. Samples were collected weekly for a period of 27 or 56 days during which the wood samples were exposed to ambient climatic conditions. Sample size ranged from 5-14 depending on the wood type. The application method, rate, and monitoring times were relevant to the proposed use pattern. Geographical, climatic, ventilation and other site conditions were relevant to the proposed use pattern.

Carboquat 250T residues in wipe samples from treated sapwood samples declined over the first two weeks with the rate of dissipation appearing to decline after week 3. Mean residues ranged from 3.26 $\mu g/cm^2$ on sampling day 0 to 0.19 $\mu g/cm^2$ on sampling day 13.

Average Carboquat 250T residues from treated heartwood samples ranged from a maximum of 8.92 $\mu g/cm^2$ on sampling day 6 to a minimum of 0.50 $\mu g/cm^2$ on sampling day 41. Residues for one board were significantly higher than for the other boards. The study authors stated that deposits of silted ACQ residue and excessive discolouration could be seen on the two boards in this replicate. They state that boards with this degree of silt deposition and discolouration from the treatment process are uncommon and would not be sold or used for the production of consumer wood products. The mean Carboquat 250T residues excluding this board ranged from 5.78 $\mu g/cm^2$ on sampling day 0 to 0.49 $\mu g/cm^2$ on sampling day 41 and the rate of dissipation appeared to decline after day 27.

Because children exhibit more intense play contact on surfaces and have a higher surface area to body weight ratio than adults, they would generally be considered to represent the maximum exposed individual in a residential scenario.

A time weighted average (TWA) transferable residue value of 1.057 $\mu g/cm^2$ was estimated for the 56 day sampling period. This TWA value may be an overestimate of transferable residues since the TWA is driven by the higher residues in the first few weeks after treatment; however, it is considered appropriate for use in the residential risk assessment.

Postapplication exposure estimates for children were generated using the approach outlined in the US EPA Draft Standard Operation Procedures for Residential Exposure Assessments and its revisions as of February 22, 2001.

Dermal exposure to Carboquat WP-50 may occur from contact with treated structures (i.e. decks, play structures, picnic tables). It was assumed that a skin surface area of 1640 cm^2 could be in contact with treated wood. This is approximately 25% of the total body surface area for a 3 year old.

Exposure = TR x SA x DA/BW

Where: TR= Transferable residues ($\mu g/cm^2$). The TWA transferable residue over the first 56 days after treatment is 1.057 $\mu g/cm^2$
SA= Surface area of exposed skin (25% of total SA for a 3 year old; 1640 cm^2)
DA= Dermal absorption (100%)
BW= Body weight (15 kg)

Exposure = (mg/kg bw/day) $\frac{1.057\ \mu g/cm^2 \times 1640\ cm^2 \times 1.0 \times 0.001\ mg/\mu g}{15\ kg}$

= 0.116 mg/kg bw/day

A dermal MOE of 104 was calculated for children exposed to treated structures based on a NOAEL of ≥12 mg/kg bw/day from the 90 day dermal study.

Incidental oral exposure to Carboquat WP-50 is expected to occur from hand-to mouth activity following contact with treated wood and from ingestion of contaminated soil around treated structures. Hand-to-mouth exposure for toddlers was estimated using the following equation:

Exposure = TR x SA x SEF x FQ x ET x CF/ BW

Where: TR= Transferable residues ($\mu g/cm^2$). The TWA transferable residue over the first 56 days after treatment is 1.057 $\mu g/cm^2$
SA= Surface area of the hands (20 cm^2/event)
SEF= Saliva extraction factor (50%)
FQ= Frequency of hand-to-mouth activity (20 events/hr for short-term exposure scenarios and 9.5 events/hr for intermediate-term exposure scenarios)
ET= Exposure time (2 hr/day)
CF= Conversion factor to convert µg units to mg for daily exposure
BW= Body weight (15 kg)

Therefore:

Exposure = (mg/kg bw/day) $\frac{1.057\ \mu g/cm^2 \times 20\ cm^2/event \times 0.50 \times 20\ events/hr \times 2\ hr/day \times 0.001\ mg/\mu g}{15\ kg}$

=0.028 mg/kgbw/day

An oral MOE of 1330 was estimated for hand-to-mouth activities for children based on a NOAEL of 37.5 mg/kg bw/day from the reproduction study in rats.

The MOEs for residential exposure to toddlers exposed dermally and orally by hand-to-mouth exposure exceed the target of 100 and are considered acceptable.

Data was not provided on the concentration of Carboquat 250T in soil around treated structures; however, data was provided on the leaching of didecyl dimethyl ammonium carbonate from treated wood blocks of Southern pine. The total percentages of didecyl dimethyl ammonium carbonate leached from the treated blocks over a 14-day period ranged from 1.4-2.0% for a retention rate ranging from 3.5 to 14 kg ai/m^3. Incidental oral exposure for children ingesting soil is expected to be negligible relative to other pathways of oral exposure (i.e. hand-to-mouth).

3.4.4 Bystander Exposure and Risk Assessment

For bystanders, exposure is expected to be much less than that of workers and is considered negligible.

4.0 Impact on the Environment

4.1 Fate and Behaviour in the Environment

Most of the fate studies submitted were on DDAC (didecyl dimethyl ammonium chloride), which were accepted as bridging data in support of Carboquat 250T (DDACarb/ Bicarb). Carboquat 250T is a mixture of didecyl dimethyl ammonium carbonate and bicarbonate, and DDAC is didecyl dimethyl ammonium chloride. The only difference between DDAC and DDA carbonate is the counter ion. The counter ion for DDAC is the negatively charged chloride ion. The counter ion for DDACarb/Bicarb is a mixture of negatively charged carbonate and bicarbonate ions. Counter ions are not part of the central quaternary ammonium molecule and are present only to balance the positively charged nitrogen atom in the quat molecule in order to maintain ionic neutrality of the system. In dilute solutions such as aquatic systems, the negatively charged counter ion is completely disassociated from the positively charged quat molecule. Under these circumstances, it is not expected that the nature of the counter ion will influence the environmental behaviour or toxicity of the quat molecule. The environmental fate and behaviour of Carboquat 250T is, therefore, expected to be the same as that of DDAC.

Carboquat 250T enters the soil through leaching from treated wood from residential construction such as decks, patios, and fencing. Studies on leaching with wood blocs of Southern pine (Table 3 of Appendix 1) indicated a maximum leaching of 0.44% during the first six hours (total of 2% over a 14-day period). Laboratory studies with DDAC indicated that it strongly adsorbs to soil particles and is immobile in soils. It has a low potential to leach and contaminate groundwater. It is persistent in soil under aerobic conditions and does not form any major transformation products.

Carboquat 250T enters aquatic systems from treated wood from docks, walkways, board walks, etc. either by direct leaching due to rain or by contact with waves, splashes, etc. Carboquat 250T is very soluble in water. Under aquatic field conditions, Carboquat 250T is moderately persistent to persistent in the water/sediment systems (water DT_{50}s: 14-54 days and sediment DT_{50}s: 165-178 days) (Table 3 of Appendix 1). At one field site, however, no dissipation was observed and the Carboquat 250T concentration increased. The maximum overall mean residue concentrations observed in water and sediment were 0.65 µg ai/L and 1486.5-2908 µg ai/kg, respectively. Field results also indicated a significant partitioning of Carboquat 250T residues from water to sediment. Biotransformation of Carboquat 250T in aquatic systems is expected to be very slow (aerobic DT_{50}: 8365 days and anaerobic DT_{50}= 6218 days). DDAC has a low potential for bioaccumulation in fish.

Carboquat 250T is a mixture of salts in aqueous solution and, therefore, has a low potential for volatilization. Carboquat 250T residues in the air and their long-range transport are not expected.

4.2 Effects on Non-Target Species

To estimate the risk of potential adverse effects on non-target species, the risk quotient method is used. The risk quotient (RA) is calculated by dividing the exposure estimate by a value representing a toxicity endpoint. A screening-level risk assessment is initially performed using the expected environmental concentrations (EECs) for a worst-case scenario (e.g., direct exposure to leachates from the treated wood) and the most sensitive toxicity endpoint. Low risk is predicted if the risk quotient is less than the trigger value of one. In these cases, no further assessment is done. For those groups of organisms for which the RQ is greater than one, a refined assessment is undertaken, which takes into consideration more realistic exposure scenarios and may consider different toxicity endpoints.

4.2.1 Effects on Terrestrial Organisms

Risk of Carboquat 250T to terrestrial organisms was based upon evaluation of toxicity data on two mammals and two bird species. The acute NOEL and LD_{50} of DDACarb to bobwhite quail were 62.5 and 95.0 mg ai/kg bw, respectively (Table 4 of Appendix 1). Signs of acute toxicity were observed among birds in all the treatment groups greater than 62.5 mg ai/kg bw. Treatment related effects, i.e., loss in body weight and reduction in feed consumption, were noted among all birds at all test levels.

In short term dietary studies, no mortality was observed in bobwhite quail up to 3160 mg ai/kg diet, whereas 10% mortality was observed in mallard duck at 5620 mg ai/kg diet. No treatment related effect on feed consumption was observed in bobwhite quail, whereas in mallard feed consumption decreased with increasing test concentration. Reduction in body weights were observed in both the birds in treatments greater than 1780 mg ai/kg diet. The 5-d dietary NOEC and LC_{50} of DDACarb to bobwhite quail were 1780 and >5620 mg ai/kg diet, respectively. The corresponding values for mallard duck were 1000 and >5620 mg ai/kg diet.

Risk Assessment: The dietary exposure to terrestrial organisms such as wild birds and mammals from the treated wood is very limited and the risk to these organisms with the proposed use was, therefore, not assessed.

4.2.2 Effects on Aquatic Organisms

Risk of Carboquat 250T to aquatic organisms was based upon evaluation of toxicity data with seven freshwater species (one invertebrate, three fish, two algae and one vascular plant). As the use of Carboquat 250T does not involve marine use, risk to estuarine/marine organisms was not assessed at this point in time. Toxicity data were, however, assessed on five marine species, i.e., two fish, two invertebrates and one diatom.

Carboquat 250T is toxic to freshwater fish on an acute basis and would adversely affect them at concentrations greater than 98 µg ai/L (LC_{50}: 269 - 758 µg ai/L)(Table 5 of Appendix 1). Long term exposure to Carboquat 250T residues in water at concentrations greater than 18 µg ai/L will result in reduced growth and sublethal effects in fish. Studies with daphnia indicated that Carboquat 250T will cause adverse acute and chronic effects on freshwater invertebrates if the concentrations in water exceeds 33 and 27 µg ai/L, respectively. With DDAC, chronic adverse effects were observed at 10 µg ai/L. Carboquat 250T is toxic to freshwater algae, diatom and vascular plants and will adversely affect the freshwater ecosystem at concentrations as low as 0.17 µg ai/L (EC_{50}: 2.23 to 31.2 for carboquat and 5.9 to 720 µg ai/L for DDAC).

Carboquat 250T is also toxic to marine fish (LC_{50}: 937 µg ai/L) and invertebrates (eastern oyster LC_{50}: 110 µg ai/L and mysid shrimp LC_{50}: 54 µg ai/L) on an acute basis. In a salinity challenge test, adverse effects on fish were observed at DDAC concentrations greater than 100 µg ai/L/. Carboquat 250T is toxic to marine diatom (LC_{50}:12.2 µg ai/L) and will adversely affect them at concentrations greater than 7 µg ai/L.

4.3 Risk Assessment

Aquatic organisms may be exposed to Carboquat 250T residues either directly from the treated wood such as docks or indirectly by the leachates of the treated wood through surface runoff/drainage into aquatic systems. As Carboquat 250T residues are strongly bound to soil particles, it has a low potential to leach through soil to contaminate the groundwater.

Risk to freshwater aquatic organisms with the use of Carboquat 250T was assessed using two typical use scenarios, docks and residential decks/fence. Risk to aquatic organisms due to surface runoff from the storage of treated wood in open lumber yards was also considered. No data were submitted on the toxicity of Carboquat 250T to amphibians. The most sensitive fish toxicity endpoint, i.e., bluegill sunfish acute LC_{50} of 269 µg ai/L, was used as a surrogate for amphibians. The exposure to amphibians was estimated by calculating the EECs in 15 cm water depth.

Docks
Screening level risk assessments with exposure scenarios of 100 % and 0.44 % leachates (Table 6 of Appendix 1) indicated that the RQ values for all the aquatic organisms exceeded the LOC (Level of Concern) of one. A refined risk assessment with a more realistic scenario was, therefore, conducted. In this scenario, the actual measured concentrations in water/sediment from the treated wood docks in aquatic field dissipation/ accumulation studies were used for the exposure estimations.

The RQ values calculated with measured water concentrations are less than LOC of one (Table 7 of Appendix 1) for all aquatic organisms . These values indicate that the use of carboquat-treated wood in docks will pose a low risk to freshwater fish, invertebrates, algae and vascular plants.

No data were, however, submitted on toxicity of sediment residues to benthic aquatic organisms and, therefore, risk to these organisms could not be assessed. Laboratory studies indicated a high potential for partitioning of residues from water to sediment and aquatic field studies indicated high residue concentrations in sediments (2908 and 1486.5 µg ai/kg in top and bottom sediments, respectively). There is, therefore, a high potential for exposure and consequent risk to sediment dwelling organisms with the use of caboquat-treated wood in docks.

Decks and Fences
Screening level risk assessments with direct exposure scenarios of leachates from decks/fences (Table 7 of Appendix 1) indicated that the RQ values for all the aquatic organisms exceeded the LOC (Level of Concern) of one. A refined risk assessment with a more realistic conservative scenario was, therefore, conducted. In this scenario, exposure concentrations were estimated using PRZM/EXAMS models (Table 6 of Appendix 1).

The RQ values (Table 7 of Appendix 1) for all the aquatic organisms tested with this scenario were less than one (Level of Concern). The use of carboquat-treated wood for decks and fences in residential areas will, therefore, pose a low risk to freshwater invertebrates, fish, amphibians, algae and plants.

Storage lumber yards and treatment plants
Treated wood is generally stored for drying in the open lumber yards at the treatment facilities and, therefore, stacked packages of treated wood are subjected to leaching due to rain. There is a potential risk for aquatic organisms if the surface runoff water containing the leachates from the stored wood enters aquatic systems. No data were, however, submitted on the concentration of carboquat residues in the leachate/runoff water from the stored wood. Label statements are, therefore, required to indicate that the surface runoff water from treated wood is not allowed into aquatic systems.

Effluents from the treatment plants containing residues of carboquat may also pose a risk to aquatic organisms if they reach aquatic systems. Label statements are required to indicate that effluents from the treatment plants are not discharged into aquatic systems.

5.0 Value

5.1 Effectiveness Against Pests

Data from a soil block laboratory study, a small-scale fungal cellar test, and five field-stake studies carried out at five different test sites over an 11-year test period were submitted. Each of these studies was found to have an appropriate experimental design and consisted of a large enough number of test rates to establish target retention rates. However, the studies were carried out using exclusively southern yellow pine (SYP), a wood species which is not representative of commercial Canadian wood species. One soil-block study was provided that compared SYP to two commercial Canadian wood species. While the net retention of the preservative was greater in the SYP, the Canadian wood species showed less decay than the SYP at the end of the test. This may be attributable to a "shell" effect, in which there is less preservative penetration, but a higher concentration around the outside of the wood. In addition, two field tests were set up using Canadian wood species treated with Carboquat WP-50 added to NW 100-C or ACQ C2-EU. These stakes will be monitored annually, but meaningful results may take some time to generate.

The efficacy of Carboquat WP-50 in combination with either NW 100-C or ACQ C2-EU was evaluated as weight loss due to decay in the soil block tests, and by visual observation of the wood condition in the fungal cellar, and field trials. These visual observations were made on an annual basis and recorded in a semi-quantitative manner.

5.1.1 Acceptable Efficacy Claims

The submitted data established effective target retention rates that are displayed in Table 5.1.1. As no above-ground data has been submitted to date, these rates were derived from ground contact data. As the above-ground exposure tends to be a much weaker decay environment than ground contact exposure, the rates are expected to be effective.

Table 5.1.1 Treatment rates as supported by data

End Use	Target Retention rate (kg/m^3)
Above Ground – Non-Structural	4
Above Ground – Structural	6.4
Ground Contact	6.4

5.2 Economics

No information provided.

5.3 Sustainability

5.3.1 Survey of Alternatives

The availability of Carboquat WP-50 will provide a modified organic component to the three other currently registered wood preservatives for treating residential lumber. In particular the Carboquat WP-50 concentrate may be less corrosive to the treating cylinder and other metal components within the treatment plant than the other ACQ-type wood preservatives. The use of naturally durable wood such as western red cedar is an alternative to treated wood for residential applications, but its use and decay resistance are limited.

The key options available for treatment of wood for residential uses are summarized in Table 8 (Appendix I).

5.3.2 Compatibility with Current Management Practices Including Integrated Pest Management

Carboquat 250T offers a new active ingredient for the treatment of wood for residential applications. The end-use product, Carboquat WP-50, which is to be added to either NW 100-C or ACQ C2-EU should be compatible with pressure treatment plants currently set up to treat with ACQ-type preservatives, but may require modifications to treatment cylinders that are set up to treat with CCA.

5.3.3 Information on the Occurrence or Possible Occurrence of the Development of Resistance

Carboquat 250T is a quaternary ammonium compound that is identical in structure to didecyldimethyl ammonium chloride (DDAC) except for having a carbonate or bicarbonate as the counter ion rather than chloride. As DDAC has been used for many years without resistance issues arising, it is not expected that resistance to Carboquat 250T will be a problem.

5.3.4 Contribution to Risk Reduction and Sustainability

Carboquat WP-50, when mixed with either NW 100-C or ACQ-C2 EU, is similar in composition to other currently registered ACQ-type wood preservatives and is not expected to have a reduced risk. However, there is evidence that Carboquat WP-50 may be less corrosive to treating plant equipment.

6.0 Toxic Substances Management Policy Considerations

The management of toxic substances is guided by the federal government's *Toxic Substances Management Policy*, which puts forward a preventive and precautionary approach to deal with substances that enter the environment and could harm the environment or human health. The policy provides decision makers with direction and sets out a science-based management framework to ensure that federal programs are consistent with its objectives. One of the key management objectives is virtual elimination from the environment of toxic substances that result predominantly from human activity and that are persistent and bioaccumulative. These substances are referred to in the policy as Track 1 substances.

During the review process, Carboquat 250T was assessed in accordance with the PMRA Regulatory Directive DIR99-03, *The Pest Management Regulatory Agency's Strategy for Implementing the Toxic Substances Management Policy*. Substances associated with the use of Carboquat 250T were also considered, including major transformation products formed in the environment, microcontaminants in the technical product and formulants in the end-use products. The PMRA has reached the following conclusions:

- Carboquat 250T does not meet the criteria for persistence. Although its sediment half-life of (178 days-no dissipation) meets the TSMP criterion of ≥ 365 d, its half-lives in air (vapour pressure indicates that it is not volatile) and water (54 days) do not meet the TSMP Track-1 cut-off criteria for air (≥2 d) and water (≥ 182 d), respectively. Carboquat 250T is not bioaccumulative. The octanol-water partition coefficient (log K_{ow}: 0) is below the TSMP Track-1 cut-off criterion of ≥5.0.

- Carboquat 250T does not form any transformation products that meet the TSMP Track-1 criteria.

- Carboquat WP-50 does not contain any formulants of health or environmental concern identified in Canada Gazette Part II, Volume 139, Number 24, pages 2641-2643: *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern*..

- Carboquat 250T does not contain any contaminants of health or environmental concern identified in Canada Gazette Part II, Volume 139, Number 24, pages 2641-2643: *List of Pest Control Product Formulants and Contaminants of Health or Environmental Concern*..

Conclusions: The use of Carboquat WP-50 as a heavy duty wood preservative is not expected to result in the entry of TSMP Track-1 substances into the environment.

7.0 Summary

7.1 Human Health and Safety

The toxicology database submitted for Carboquat 250T is adequate to define the majority of toxic effects that may result from human exposure to Carboquat 250T. Carboquat 250T is a quaternary ammonium compound, and as such the most prominent effects observed in the database reflect the highly irritating nature associated with this class of chemicals. In subchronic and chronic studies on laboratory animals, there was no specific target organ toxicity. Generalized toxicity was observed in rats, mice and dogs as decreases in body weight and body weight gain. There was no evidence of carcinogenicity in rats or mice after longer-term dosing. There was no evidence of increased susceptibility of the young in reproduction or developmental toxicity studies. Carboquat 250T is not considered to be a neurotoxicant.

Mixer, loader, applicators and workers handling treated wood are not expected to be exposed to levels of Carboquat 250T that will result in unacceptable risk when Carboquat WP-50 is used according to label directions. The personal protective equipment on the product label is adequate to protect workers, and no additional personal protective equipment is required.

Residential exposure to individuals contacting treated structures is not expected to result in unacceptable risk when Carboquat WP-50 is used according to label directions.

7.2 Environmental Risk

Carboquat 250T is persistent in soil and water/sediment systems. An environmental assessment with the use of Carboquat WP-50 as a heavy duty wood preservative has identified the following concerns:

- high concentrations of bound residues in sediments may pose a risk to sediment dwelling organisms
- aquatic organisms may be at risk if aquatic systems are exposed to surface runoff from the stacked treated wood in the open lumber yards and effluents from the treatment plants

7.3 Value

The data submitted to register Carboquat WP-50 were adequate to demonstrate its efficacy for use as a wood preservative to treat residential lumber. Carboquat WP-50 offers a modified wood preservative chemistry that may be less corrosive to the cylinder and equipment within wood treatment plants. Furthermore, the availability of Carboquat WP-50 will provide both wood treaters and users with a new alternative for residential treated wood in a market in which there are currently a small number of alternatives.

7.4 Unsupported Uses

Certain uses originally proposed with this application are not supported by the PMRA because value has not been adequately demonstrated. Unsupported uses are outlined in Table 9 (Appendix I).

8.0 Proposed Regulatory Decision

Health Canada's PMRA, under the authority of the *Pest Control Products Act*, is proposing full registration for the sale and use of the technical grade active ingredient Carboquat 250T and the end-use product Carboquat WP-50 as a heavy duty wood preservative for wood destined for non-industrial above-ground and ground contact uses. An evaluation of current scientific data from the applicant and scientific reports have resulted in the determination that, under the proposed conditions of use, the end-use product has value and does not present an unacceptable risk to human health or the environment.

List of Abbreviations

µg	micrograms
1/n	exponent for the Freundlich isotherm
a.i.	active ingredient
ADI	acceptable daily intake
ALS	acetolactate synthase
ARfD	acute reference dose
atm	atmosphere
bw	body weight
CAS	chemical abstracts service
cm	centimetres
DF	dry flowable
DNA	deoxyribonucleic acid
DT_{50}	dissipation time 50% (the dose required to observe a 50% decline in the test population)
DT_{75}	dissipation time 75% (the dose required to observe a 75% decline in the test population)
EC_{10}	effective concentration on 10% of the population
EC_{25}	effective concentration on 25% of the population
ER_{25}	effective rate for 25% of the population
g	gram
ha	hectare(s)
HDT	highest dose tested
Hg	mercury
HPLC	high performance liquid chromatography
IUPAC	International Union of Pure and Applied Chemistry
kg	kilogram
K_d	soil-water partition coefficient
K_F	Freundlich adsorption coefficient
km	kilometre
K_{oc}	organic-carbon partition coefficient
K_{ow}	*n*–octanol-water partition coefficient
L	litre
LC_{50}	lethal concentration 50%
LD_{50}	lethal dose 50%
LOAEL	lowest observed adverse effect level
LOEC	low observed effect concentration
LOQ	limit of quantitation
LR_{50}	lethal rate 50%
mg	milligram
mL	millilitre
MAS	maximum average score
MOE	margin of exposure
MRL	maximum residue limit
MS	mass spectrometry
N/A	not applicable

NOAEL	no observed adverse effect level
NOEC	no observed effect concentration
NOEL	no observed effect level
NOER	no observed effect rate
N/R	not required
NZW	New Zealand white
OC	organic carbon content
OM	organic matter content
PBI	plantback interval
PHI	preharvest interval
p*K*a	dissociation constant
PMRA	Pest Management Regulatory Agency
ppm	parts per million
RSD	relative standard deviation
SC	soluble concentrate
$t_{1/2}$	half-life
T3	tri-iodothyronine
T4	thyroxine
TRR	total radioactive residue
TSMP	Toxic Substances Management Policy
UAN	urea ammonium nitrate
UF	uncertainty factor
USEPA	United States Environmental Protection Agency
UV	ultraviolet
v/v	volume per volume dilution

Appendix I Tables and Figures

Table 1 Acute Toxicity of Carboquat 250T and Its Associated End-use Product (Carboquat WP-50)

Study Type	Species	Result	Comment	Reference
Acute Toxicity of Carboquat 250T (Technical)/Carboquat WP-50 (End-Use Product)				
Oral	Rat	LD_{50} (combined) = 245 mg/kg bw/day	High toxicity	728064
Skin irritation	Rabbit	MAS[a] - not determined MIS[b] = 7/8	Extremely irritating	728075
Skin sensitization (Photoallergy study)	Guinea pig	Negative	Not a dermal sensitizer	728078
Skin sensitization (Buehler) *using DDAC	Guinea pig	Negative	Not a dermal sensitizer	1011676

[a] MAS = maximum average score for 24, 28 and 72 hours
[b] MIS = maximum irritation score

Table 2 Toxicity Profile of Carboquat 250T

Note: A bridging rationale was provided (and determined to be acceptable) to use the metabolism and repeat-dose studies conducted with didecyl dimethyl ammonium chloride (DDAC) in support of Carboquat 250T Technical. Therefore, unless otherwise indicated, all studies listed below were conducted with DDAC.

Study Type	Species	Results[a] (mg/kg/day in ♂/♀)	Reference
21-day dermal irritation	Rat	Dermal irritation: NOAEL: 10 µg/cm²/day	1284326
90-day dermal	Rat	Systemic toxicity: NOAEL: >12 LOAEL: not established Dermal irritation: NOAEL: not established LOAEL: ≤2; based on irritation noted at all dose levels	1226314
90-day dietary	Mouse	NOAEL: 107/134 LOAEL: 182/224; based on decreased body weight gain (primarily in males) and thymic hemorrhage in females	1226313
90-day dietary	Rat	NOAEL: 61/74 LOAEL: >150; based on mortality in both sexes (actual intake on a mg/kg basis could not be accurately determined due to confounding mortality and food spillage)	1226312

Study Type	Species	Results[a] (mg/kg/day in ♂/♀)	Reference
1-year dietary	Dog	NOAEL: 3 LOAEL: 10; based on increased emesis in males and soft feces.	1239055
Carcinogenicity (18-month dietary)	Mouse	NOAEL: 15/18.6 LOAEL: 76.3/93.1 Based on decreased body weight gain in both sexes.	1236493
Chronic/ Carcinogenicity (2-year dietary)	Rat	NOAEL: 32/41 LOAEL: 64/83 Based on decreases in body weight, body weight gain, & food consumption, and histopathological changes in the mesenteric lymph nodes	1239056, 1239057
Two-generation reproduction	Rat	**Parental toxicity**: NOAEL: 37.5 LOAEL: 75 Based on decreased body weight and body weight gain, and histopathology of the lymph node in males **Offspring toxicity:** NOAEL: 37.5 LOAEL: 75 Based on decreased body weight and body weight gain in both generations **Reproductive toxicity:** NOAEL: 75 LOAEL not established	1236492
Developmental toxicity	Rat	**Maternal:** NOAEL: 1 LOAEL: 10 Based on ↑in audible respiration. **Developmental:** NOAEL: 20 LOAEL: not established	1239058
Developmental toxicity	Rabbit (NZW)	**Maternal:** NOAEL: 1 LOAEL: 3 Based on decreased body weight gain and clinical signs of toxicity **Developmental:** NOAEL: 3 LOAEL: 10 Based on increased number of dead fetuses per litter and decreased fetal body weights	1226315
Reverse gene mutation assay	*Salmonella typhimurium*	Negative	1214219
Gene mutations in mammalian cells in vitro	Chinese hamster ovary cells	Negative	1226288

Study Type	Species	Results[a] (mg/kg/day in ♂/♀)	Reference
In vitro unscheduled DNA synthesis	Primary rat hepatocytes	Negative	1226301
In vitro mammalian chromosomal aberration	Chinese hamster ovary cells	Negative	1214218
In vivo mammalian cytogenetics	Rat	Negative	1214220
Metabolism	Rat	**Absorption and Excretion** Limited absorption. Primarily excreted in the feces in both sexes (89 - 99.5%). Urine accounted for 1.2 - 2.4% of excretion. Low doses excreted by 38h in both sexes. The single high dose was excreted in the feces of both sexes by 72h, however urinary excretion was highly variable between the sexes and within females (males excreted the compound within 24 hrs while females excreted the compound within 36-144 hrs). **Distribution** Tissue residues were very low after all dosing regimes (0.003 - 0.675%), indicating very little deposit of the test article. **Metabolism** Analysis of feces indicated mostly parent in both males (54-66%) and females (37-59%). Four minor metabolites were noted, formed from oxidative modification of the decyl side chain. Females demonstrated a more extensive metabolism of DDAC than males.	1236494, 1236495

[a] Effects observed in males as well as females unless otherwise reported

Table 3 Fate and Behaviour in the Environment

Terrestrial environment			
Property	**Test substance**	**Value**	**Comments**
Abiotic transformation			
Hydrolysis	DDAC	no significant transformation	stable to hydrolysis
Phototransformation on soil	DDAC	132 d	not a principle route
Biotransformation			
Biotransformation in aerobic soil	DDAC	1080 d	not a principle route of transformation; persistent under aerobic conditions
Biotransformation in anaerobic soil	no data submitted; data submitted on anaerobic aquatic systems are, however, acceptable in lieu of these data		

Terrestrial environment			
Property	**Test substance**	**Value**	**Comments**
Mobility			
Adsorption	DDAC	% adsorption: 84.44-99.46 K_d: 1095-30851 K_{oc}: 437805-1599564	strongly adsorbed and immobile in soils
Field studies			
Field leaching	Bardac 22C (DDACarb)	total in leachates: 1.4-2.0% maximum % leached (1st 6 h): 0.44%	low potential for leaching from treated wood
Aquatic environment			
Abiotic transformation			
Hydrolysis	DDAC	no significant transformation	stable to hydrolysis
Phototransformation in water	DDAC	DT_{50}= 227 d	not a principle route
Biotransformation			
Biotransformation in aerobic water systems	DDAC	8365 d	not a principle route; persistent under aerobic conditions
Biotransformation in anaerobic water systems	DDAC	6218 d	not a principle route; persistent under anaerobic conditions
Field studies			
Field dissipation	Carboquat WP-50	DT_{50} (days): water: 54 sediment: 165-178 and no dissipation	moderately persistent to persistent
		Max concentrations: water: 0.65 µg /L sediment:1486.5-2908.6 µg/kg	

Table 4 Toxicity to Non-Target Terrestrial Species

Effects on terrestrial organisms					
Organism	**Exposure**	**Test substance**	**Endpoint value**		**Classification of toxicity[a]**
			NOEC	**LD_{50}/EC_{50}**	
Birds					
Bobwhite quail	Acute	DDACarb	62.5 mg ai/kg bw	95.0 mg ai/kg bw	moderately toxic
	Dietary	DDACarb	1780 mg ai/kg	>5620 mg ai/kg	non-toxic
	Reproduction	no data submitted			
Mallard duck	Dietary	DDACarb	1000 mg ai/kg	>5620 mg ai/kg	non-toxic
	Reproduction	no data submitted			
Mammals					
Rat	Acute	DDACarb	na	245 mg ai/kg bw	moderately toxic
	Dietary	na	1000 mg ai/kg bw	na	
	Reproduction	na	750 mg ai/kg bw	na	
Mouse	Dietary	na	600 mg ai/kg bw	na	

na: not available

Table 5 Toxicity to Non-Target Aquatic Species

Effects on aquatic organisms					
Organism	**Exposure**	**Test substance**	**Endpoint values**		**Classification of toxicity[a]**
			NOEC (µg ai/L)	**LC_{50}/EC_{50} (µg ai/L)**	
Freshwater species					
Water flea *(Daphnia magna)*	Acute	DDACarb	33	64	very highly toxic
	Chronic	Bardac 22C50	27	77	
	Chronic	DDAC	10	23	
Rainbow trout *(Oncorhynchus mykiss)*	Acute	DDACarb	580	758	highly toxic
Bluegill sunfish *(Lepomis macrochirus)*	Acute	DDACarb	98	269	highly toxic

Effects on aquatic organisms					
Organism	**Exposure**	**Test substance**	**Endpoint values**		**Classification of toxicity[a]**
			NOEC (µg ai/L)	**LC_{50}/EC_{50} (µg ai/L)**	
Fathead Minnow *(Pimephales promelas)*	chronic: larvae survival	Bardac 22C50	86	170 (LOEC)	
	chronic: growth		18	32 (LOEC)	
Freshwater alga: blue-green alga *(Anabaena flos-aquae)*	Acute: cell density	DDACarb	<3.0	46.5	
	acute:biomass		<3.0	47.2	
	acute: growth rate		<3.0	61.2	
Freshwater alga: green alga *(S.capricornutum)*	acute: cell density	DDAC	25	77.6	
	acute:biomass		25	82.4	
	acute: growth rate		25	nd	
Freshwater alga: green alga *(S.capricornutum)*	acute: cell density	DDAC	0.17	6	
	acute:biomass		0.17	5.9	
	acute: growth rate		0.17	22	
Freshwater alga: green alga *(S. subspicatus)*	acute: cell density	DDAC	200	560	
	acute: biomass		200	550	
	acute: growth rate		200	720	
Freshwater diatom *(Navicula pelliculosa)*	acute: cell density	DDACarb	0.98	6.3	
	acute: biomass		<0.43	2.23	
	acute: growth rate		0.43	10.03	
Vascular plant (*Lemna* sp)	acute: frond number	DDACarb	0.82	5.2	phytotoxic
	acute: biomass		0.82	5.9	
	acute: growth rate		0.82	55.3	
Marine species					
Crustacean (eastern oyster)	acute	DDACarb	25	110	highly toxic
Mysid shrimp (*Mysidopsis bahia*)	acute	DDACarb	30	54	very highly toxic
Fish: Sheepshead minnow *(Cyprinodon variegatus)*	acute	DDACarb	890	937	highly toxic

Effects on aquatic organisms					
Organism	**Exposure**	**Test substance**	**Endpoint values**		**Classification of toxicity[a]**
			NOEC (µg ai/L)	**LC_{50}/EC_{50} (µg ai/L)**	
Salmonid (coho salmon: *Oncorhynchus kisutch*)	salinity challenge	DDAC	100		
Marine diatom *(Skeletonema costatum)*	acute: cell density	DDACarb	7	13.6	
	acute: biomass		7	12.2	
	acute: growth rate		7	37.5	

[a]US EPA classification, where applicable

Table 6 Expected Environmental Concentrations in Water

EEC in water with docks	
Screening Level :	
Dock size: 20' x 4' x 2" (6.1m x 1.2 m x 0.05 m):	0.366 m^3 /dock
Treated area for 1 ha of 6 docks:	2.20 m^3/ha
Carboquat (EP) used to treat 1 ha of 6 docks (2.20 x 6.4 kg EP/m^3)	14.08 kg EP/ha
Carboquat (ai) used to treat 1 ha of 6 docks (50% ai)	7.04 kg ai/ha
EEC in 1 ha of 0.8 m water depth:	880 µg ai/L
Refined RA 1:	
Maximum % of DDACarb that leaches form the treated wood	0.44%
EEC in water with 0.44% leaching in 1 ha of 6 docks	3.89 µg ai/L
Refined RA 2:	
Maximum concentration in water with aquatic field studies	0.65 µg ai/L
Maximum concentration in sediment with aquatic field studies	2908 µg ai/kg

EEC in water due to leaching from decks/fences						
Residential exposure scenario calculation of treated wood area						
Item	Width (ft)	Height (ft)	Length (ft)	Number	Volume ft^3	Volume m^3
					$ft^3/m^3 = 35.32$	
Deck section, 10 ft x 12 ft						
Beams	0.292	1.00	12	2	7.01	0.20
Crosspieces	0.125	0.63	10	10	7.81	0.22
Side caps, long	0.125	1.00	12	2	3.00	0.08
Sidecaps, short	0.125	1.00	10	2	2.50	0.07
Posts	0.292	0.29	4	6	2.05	0.06
Deck boards	0.125	0.46	12	21	14.43	0.41
Sub total					36.79	1.04
Railing, 6 ft x 252 ft						
Cornet post	0.292	0.292	4.5	3	1.15	0.03
Cap long	0.125	0.458	12	1	0.69	0.02
Cap short	0.125	0.458	10.92	2	1.25	0.04
Slats	0.125	0.125	3.63	61	3.46	0.10
Crosspieces long	0.125	0.292	12	2	0.88	0.02
Crosspieces short	0.125	0.292	10	4	1.46	0.04
Sub total					8.88	0.25
Satirs and misc @ 10%					4.57	0.13
Total deck x 2 (20 x 12 ft)					100.50	2.85
Fence (6 ft x 100 ft)						
Posts	0.292	0.292	8	12	8.19	0.232
Upright board	0.063	0.458	6	218	37.74	1.069
Cross pieces	0.125	0.292	8	24	7.01	0.198
Total fence					52.93	1.499
Total wood treated area per house					153.43	**4.35**
Application rate (kg EP/m3):					6.4	
Total kg EP used per house (6.4 kg EP x 4.35 m3):					27.81	
Total kg ai used per house (50% ai):					13.9	
1 ha urban area (10000 m^2) with 50% houses (after roads, schools, parks etc and 50% houses with no decks) (m^2):					5000	
Typical each house area (50 ft x 110 ft) (m2):					511	
Number of houses in 1 ha urban area (5000 m2)					10	
Kg ai used per ha (no of houses x kg ai per house):					139.05	
Maximum amount (kg) that can be leached per ha (max 0.44%):					0.6118	
Volume of water (liters) in a shallow lake of 1 ha (100m x 100 m x 0.8 m):					8000000	

EEC in water due to leaching from decks/fences		
Screening Level (100% leachate from 10 ha draining directly into 1 ha pond)		
Concentration (µg ai/L) in a shallow lake (0.8 m depth) water of 1 ha	**764.76**	
Concentration (µg ai/L) in a shallow lake water (0.15 m depth) of 1 ha	**4078.7**	
Refined RA (Estimation with PRZM/EXAMS 10 ha urban area drained into 1 ha lake/pond)		
Estimated maximum concentration in mg/ha in off field area	339.41	
Concentration (µg ai/L) in a shallow lake water (0.8 m depth) of 1 ha	**0.42**	
Concentration (µg ai/L) in a shallow lake water (0.15 m depth) of 1 ha	**2.26**	

Table 7 Refined Risk Assessment on Non-Target Species

Risk to freshwater aquatic organisms									
Organism	**Exposure**	**Endpoint value**	**RQ (Docks)**				**RQ (Decks and fence)**		
			Screening: EEC: 880	**Refined 1: EEC: 3.89**	**Refined 2: EEC: 0.65**	**Risk (Refined 2)**	**Screening 1: EEC:764.76 *EEC: 4078.7**	**Refined: EEC: 0.42 *EEC: 2.26**	**Risk (Refined)**
Daphnids (*Daphnia magna*)	acute	LC_{50}: 64	27.5	0.12	0.02	no risk	23.9	0.01	no risk
	chronic	NOEC: 10 (DDAC)	88	0.39	0.07	no risk	76.48	0.04	no risk
Coldwater fish: (rainbow trout)	acute	LC_{50}: 758	11.6	0.05	0.01	no risk	10.09	0.01	no risk
Warm water: (bluegill sunfish)	acute	LC_{50}: 269	32.7	0.15	0.02	no risk	28.43	0.02	no risk
Freshwater: (fathead minnow)	chronic	NOEC: 18	48.9	0.22	0.04	no risk	42.49	0.02	no risk
Amphibians	acute	**LC_{50}: 269	na	na	na	na	151.6	0.08	no risk
	chronic	**NOEC: 18	na	na	na	na	226.59	0.13	no risk
Freshwater alga (green alga)	acute	EC_{50}: 6 (DDAC)	293.3	1.3	0.22	no risk	254.92	0.14	no risk
Vascular plant (*Lemna* sp)	acute	EC_{50}: 5.2	338.5	1.5	0.25	no risk	294.14	0.16	no risk

Note: All the toxicity concentrations and EECs are µg ai/L
* EEC in 15 cm water depth and **toxicity end point of fish as a surrogate were used for amphibian RA
Aquatic invertebrates, algae and plants: RQ = EEC/(EC_{50}÷2)
All other aquatic organisms: EEC/(LC_{50}÷10)
na: not assessed

Table 8 Alternative wood preservatives for the treatment of wood for residential uses

End-Use Product	PCP#	Actives	Registered Uses
ACQ 2102	27130	COPPER ETHANOLAMINE COMPLEXES; N-ALKYL (67% C12, 25% C14, 7% C16, 1% C18) DIMETHYL BENZYL AMMONIUM CHLORIDE	Non-Industrial Wood; Above-Ground Ground Contact
NW 100	27131	CUPROUS OXIDE; N-ALKYL (67% C12, 25% C14, 7% C16, 1% C18) DIMETHYL BENZYL AMMONIUM CHLORIDE	Non-Industrial Wood; Above-Ground Ground Contact
Wolman NB	27132	CUPROUS OXIDE; TEBUCONAZOLE	Non-Industrial Wood; Above-Ground Ground Contact Fresh Water Contact

Table 9 Use Claims Proposed by Applicant and Whether Acceptable or Unsupported

Applicant-Proposed Label Claims	Accepted Label Claims	Unsupported Label Claims
To be used in combination with registered alkaline copper wood preservatives	To be used in combination with either NW 100-C or ACQ-C2 EU	
Can be used alone or in combination with other registered organic and inorganic wood preservatives		Can be used alone or in combination with other registered organic and inorganic wood preservatives
Pressure treatment Double Vacuum	Pressure treatment	Double Vacuum
For use as a heavy duty wood preservative in the treatment of non-industrial wood for above ground and ground contact.	For use as a heavy duty wood preservative in the treatment of non-industrial wood for above ground and ground contact.	

References

A. LIST OF STUDIES/INFORMATION SUBMITTED BY REGISTRANT

1.0 Chemistry Assessment

PMRA Document Number	Reference
935943	CHEMICAL AND PHYSICAL PROPERTIES. CARBOQUAT WP-50. (COLOUR, PHYSICAL STATE, ODOUR, FORMULATION TYPE, CONTAINER MATERIAL AND DESCRIPTION, DENSITY OR SPECIFIC GRAVITY, PH, OXIDIZING OR REDUCING ACTION, VISCOSITY, STORAGE STABILITY DATA, FLAMMABILITY, EXPLODABILITY, MISCIBILITY, CORROSION CHARACTERISTICS, DIELECTRIC BREAKDOWN VOLTAGE.
1011749	Oxidizing/reducing action, Waiver Request. Dell Tech Laboratories Ltd. DACO: 3.5.8
1011750	Caroquat WP-50: Corrosion Characteristics, Waiver Request. Dell Tech Laboratories Ltd.. DACO: 3.5.15
1011677	Determination of the Photolysis Rate of Didecyldimethylammoniumchloride (DDAC) in pH 7 Buffered Solution at 25C. 1989. Report Number 37005. DACO: 8.2.3.3.2
1011678	Determination of the Photolysis Rate of Didecyldimethylammoniumchloride on the Surface of Soil. 1992. Report Number 39505. DACO: 8.2.3.3.1
1077369	Determination of Quat Composition in Carboquat 250T and Quantification of Carbonate and Bicarbonate. DACO: 2.13.2
1077370	Preliminary Analysis. 2005. Report Number 16888. DACO: 2.13.3
1077371	Storage Stability and Corrosion Characteristics. 2005. Report Number 15726. DACO: 2.14.13
1118456	EVALUATION OF THE CORROSION CHARACTERISTICS OF CARBOQUAT® 250T USING A LABORATORY IMMERSION CORROSION TEST. 2005. Report Number 33-587. DACO: 2.14.13
1118458	Accelerated Storage Stability Study. 2005. Report Number 17828. DACO: 2.14.13
1147753	Determination of Total Free Amine in Carboquat 250T, Batch # G4223431 by Titration Method. 2005. DACO: 2.13.1
1147757	Karl Fischer Determination of Water in DDA Carbonate/Bicarbonate. 2006. DACO: 2.13.1
1393814	Carbonate/Bicarbonate in Carboquat [analytical method]. 2006. DACO: 2.13.1
1393816	Carbonate Titration With Correction for Amine Rev1 [Batch Data]. 2006. DACO: 2.13.3
1393826	US Patent Application for IN SITU PROCESS FOR MAKING QUATERNARY AMMONIUM BICARBONATES AND QUATERNARY AMMONIUM CARBONATES. 2004. DACO: 2.11.2
1395099	Carboquat Product Chemistry - Recalculation of Study Results Rev 0. DACO: 2.13.3

1396370	Description of the Discussion of Formation of Impurities. DACO: 2.11.4
1396371	Establishing Certified Limits. DACO: 2.12.1
1396388	Sample(s) of Analytical Standards and ROC. DACO: 2.15
1396486	Chemistry Requirements for the Registration of a TGAI. DACO: 2.1,2.2,2.3.1,2.4,2.5,2.6,2.7,2.8,2.9
1396487	Manufacturing Summary. DACO: 2.11.1
1396488	Description of Starting Materials. , DACO: 2.11.2
1396490	Detailed Production Process Description,. DACO: 2.11.3
1396492	Amended Final Report Carboquat - Preliminary Analysis. 2003. Lonza Inc., Report Number SP-02049-A. DACO: 2.13.2
1396494	Chemical and Physical Properties: Carboquat 250T. DACO: 2.14.1,2.14.2,2.14.3,2.14.6
1396495	Carboquat - Physical and Chemical Properties. 2002. Lonza Inc., Report Number SP-02046-A. DACO: 2.14.1,2.14.2,2.14.3,2.14.6
1396497	Melting Point + Boiling Point + Water Solubility + Solvent Solubility + Vapour Pressure, waiver request + Dissociation Constant, waiver request + Octanol/Water Partition Coefficient, waiver request + UV Visible spectrum + Stability and Storage Stability.

2.0 Impact on Human and Animal Health

PMRA Document Number	Reference
728063	Comparison of Results for Studies Conducted with Didecyl Dimethyl Ammonium Carbonate and Didecyl Dimethyl Ammonium Chloride. DACO: 4.1
728064	Acute Oral Toxicity in Rats - Median Lethal Dosage Determination Using a 5% Active Ingredient Formulation of Didecyl Dimethyl Ammonium Carbonate. 1994. Report Number 93-8185-21. DACO: 4.2.1
728075	Primary Skin Irritation Study in Rabbits Using a 50% Active Ingredient Formulation of Didecyl Dimthyl Ammonium Carbonate. 1994. Report Number 93-8185-21. DACO: 4.2.5
728078	Photoallergy Study with Didecyl Dimethyl Ammonium Carbonate in Guinea Pigs. 1994. Report Number 93-8123-21. DACO: 4.2.6
930464	Waiver Request, DACO: 4.2.2
930466	Waiver Request, DACO: 4.2.3
930468	Waiver Request, DACO: 4.2.4
1011676	Dermal Sensitization Test in Guinea Pigs. 2004. Report Number 15512. DACO: 4.2.6
1284326	21 Day Repeated Dose Dermal Irritation Study with Carboquat in Female Rats. 2006. Report Number 19072. DACO: 4.3.8

1214218 CHROMOSOMAL ABERRATIONS ASSAY WITH CHO CELLS IN VITRO. 1986. Report Number 4236. DACO: 4.5.4

1214219 SALMONELLA/MAMMALIAN - MICROSOME ASSAY WITH BARDAC 22. 1982. DACO: 4.5.4

1214220 ANALYSIS OF METAPHASE CHROMOSOMES OBTAINED FROM BONE MARROW OF RATS. 1987. Report Number LZA 24/8761. DACO: 4.5.4

1214221 TERATOLOGIC EVALUATION OF THREE QUATERNARY COMPOUNDS. 1977. Report Number 5155/2224A. DACO: 4.5.2

1226288 MUTAGENICITY TEST ON DDAC IN THE CHO/HGPRT FORWARD MUTATION ASSAY. 1988. Report Number 10141-0-435. DACO: 4.5.4

1226301 MUTAGENICITY TEST ON DDAC IN THE RAT PRIMARY HEPATOCUTE UNSCHEDULED DNA SYNTHESIS ASSAY. 1988. Report Number 10141-0-447. DACO: 4.5.4

1226312 NINETY-DAY DIETARY SUBCHRONIC ORAL TOXICITY STUDY WITH DDAC IN RATS. 1988. Report Number 51-506. DACO: 4.3.1

1226313 SUBCHRONIC DIETARY DOSE RANGE FINDING STUDY WITH DDAC IN MICE. 1988. Report Number 51-507. DACO: 4.3.1,4.3.8

1226314 NINETY-DAY SUBCHRONIC DERMAL TOXICITY STUDY WITH DDAC IN RATS. 1988. Report Number 51-554. DACO: 4.3.4

1226315 DEVELOPMENTAL TOXICITY STUDY OF DDAC ADMINISTERED BY GAVAGE TO NEW ZEALAND WHITE RABBITS. 1989. Report Number 51-590. DACO: 4.5.2

1236492 TWO-GENERATION REPRODUCTION STUDY IN SPRAGUE-DAWLEY (CD) RATS WITH DIDECYLDIMETHYLAMMONIUMCHLORIDE ADMINISTERED IN THE DIET. 1991. Report Number 52-648. DACO: 4.5.1

1236493 CHRONIC DIETARY ONCOGENICITY STUDY WITH DIDECYLDIMETHYLAMMONIUMCHLORIDE IN MICE. 1991. Report Number 53-528. DACO: 4.4.1,4.4.2

1236494 ADDENDUM TO REPORT ENTITLED "ABSORPTION, DISTRIBUTION, METABOLISM AND EXCRETION STUDIES OF DIDECYLDIMETHYLAMMONIUMCHLORIDE (DDAC) IN THE RAT. 1989. Addendum to Report Number P01421. DACO: 4.5.9,6.4

1236495 ABSORPTION, DISTRIBUTION, METABOLISM AND EXCRETION STUDIES OF DIDECYLDIMETHYLAMMONIUMCHLORIDE (DDAC) IN THE RAT. 1989. Report Number P01421. DACO: 4.5.9,6.4

1239055 CHRONIC ORAL TOXICITY STUDY OF DIDECYLDIMETHYLAMMONUIM CHLORIDE IN DOGS. 1991. Report Number 2545-102. DACO: 4.3.1

1239056 CHRONIC DIETARY TOXICITY/ONCOGENICITY STUDY WITH DIDECYLDIMETHYLAMMONIUMCHLORIDE IN RATS. 1991. Report Number 53-566. DACO: 4.4.1,4.4.2

1239057 CHRONIC DIETARY TOXICITY/ONCOGENICITY STUDY WITH DIDECYLDIMETHYLAMMONIUMCHLORIDE IN RATS. 1991. Report Number 53-566. DACO: 4.4.1,4.4.2

1239058	DEVELOPMENTAL TOXICITY EVALUATION OF DIDECYLDIMETHYLAMMONIUMCHLORIDE ADMINISTERED BU GAVAGE TO CD (SPRAGUE-DAWLEY) RATS. 1991. Report Number 53-534. DACO: 4.5.2
1141185	Determination of Dislodgeable Carboquat Residues from Sapwood Boards Pressure Treated with an Ammoniacal Copper Quat (ACQ) Formulation - Part I. 2006. Report Number 2005-CT-ACQ-PS. DACO: 5.9
1141186	Determination of Dislodgeable Carboquat Residues from Sapwood Boards Pressure Treated with an Ammoniacal Copper Quat (ACQ) Formulation - Part II. 2006. Report Number 2005-CT-ACQ-PS. DACO: 5.9
1284320	Determination of Dislodgeable Carboquat Residues From Heartwood Boards Pressure Treated with ACQ Formulation. 2006. DACO: 5.9

3.0 Impact on the Environment

PMRA Document Number	Reference
728095	Determination of the Leachability of Bardac 22C from Treated Wood. 2001. Report Number 2000-CT-WL-B22C. DACO: 8.6
930888	Executive Summary of 8.6 (Determination of the Leachability of Bardac 22C from Treated Wood., Report Number 2000-CT-WL-B22C. DACO: 8.1
1011673	Incineration Waiver Request, Dell Tech Laboratories, DACO: 8.5.2
1011677	Determination of the Photolysis Rate of Didecyldimethylammoniumchloride (DDAC) in pH 7 Buffered Solution at 25C. 1989. Report Number 37005. DACO: 8.2.3.3.2
1011678	Determination of the Photolysis Rate of Didecyldimethylammoniumchloride on the Surface of Soil. 1992. Report Number 39505. DACO: 8.2.3.3.1
1011679	Hydrolysis of Didecyldimethylammoniumchloride (DDAC) as a Function of pH at 25°C. 1989. Report Number 37004. DACO: 8.2.3.2
1011680	Aerobic Soil Metabolism of ^{14}C-Didecyldimethylammoniumchloride (^{14}C-DDAC). 1991. Report Number 37006. DACO: 8.2.3.4.2
1011681	Aerobic Aquatic Metabolism of ^{14}C-Didecyldimethylammoniumchloride (^{14}C-DDAC). 1991. Report Number 37008. DACO: 8.2.3.5.2
1011682	Anaerobic Aquatic Metabolism of ^{14}C-Didecyldimethylammoniumchloride (^{14}C-DDAC). 1991. Report Number 37007, DACO: 8.2.3.5.6
1011683	Soil/Sediment Adsorption-Desorption of ^{14}C-Didecyldimethylammoniumchloride (DDAC). 1989. Report Number 37009. DACO: 8.2.4
1345651	Environmental Monitoring for Didecyldimethylammoniumcarbonate/bicarbonate (Carboquat) Residues in Water, Sediment, and Soil from Aquatic Systems Containing Piers/Docks Constructed from Wood Pressure-Treated with Carbquat WP-50. 2006. Vol I of II, Report Number TCI-04-107.
1345652	Environmental Monitoring for Didecyldimethylammoniumcarbonate/bicarbonate (Carboquat) Residues in Water, Sediment, and Soil from Aquatic Systems Containing Piers/Docks Constructed from Wood Pressure-Treated with Carbquat WP-50. 2006. Vol II of II, Report Number TCI-04-107.

1345653	Validation of the Residue Analytical Method: Determination of Carboquat (N,N-Didecyl-N,N-dimethylammonium Carbonate/Bicarbonate; CAS RN 148788-55-0 and CAS RN 148812-65-1) in Biota (Fish Tissue). 2006. Report Number ML05-1277-LON. DACO: 8.2.2
728096	Risk Assessment for the Fresh Water Aquatic Wood Preservation Wood Pattern for Didecyl Dimethyl Ammonium Carbonate. 2002. DACO: 9.1
728098	Intermittent flow through reproduction test with didecyldimethylammonium chloride and Daphnia magna. 2001. Report Number 99-9048-04. DACO: 9.3.2
728101	Didecyl Dimethyl Ammonium Carbonate: An Acute Oral Toxicity Study with the Northern Bobwhite. 1994. Report Number 289-112. DACO: 9.6.2.1
728103	Didecyl Dimethyl Ammonium Carbonate: A Dietary LC50 Study with the Northern Bobwhite. 1994. Report Number 289-110A. DACO: 9.6.2.4
728105	Didecyl Dimethyl Ammonium Carbonate: A Dietary LC50 Study with the Mallard. 1994. Report Number 289-111. DACO: 9.6.2.5
1011674	A Flow-Through Life-Cycle Toxicity Study of Bardac 22C50 with the Caldoceran (Daphnia magna). 2004. Report Number 289A-162. DACO: 9.3.3
1011684	Salinity Challenge Waiver Request, Dell Tech Laboratories, Ltd., DACO: 9.5.2.4.1
1011685	An Early Life-Stage Toxicity Test of Bardac 22C50 with the Fathead Minnow (Pimephales promelas). 2004. Report Number 289A-155. DACO: 9.5.3.1
1011686	Bioconcentration and Elimination of 14 C- Residues by Bluegill (Lepomis macrochirus) Exposed to Didecyldimethylammonium Chloride (DDAC). 1990. Report Number 89-7-3043. DACO: 9.5.6
1011688	A 96-Hour Toxicity Test of Bardac 22C50 With the Freshwater Diatom (Navicula pelliculosa). 2004. Report Number 289A-160. DACO: 9.8.2
1011689	A 96-Hour Toxicity Test of Bardac 22C50 With the Freshwater Alga (Anabaena flos-aquae). 2004. Report Number 289A-158. DACO: 9.8.2
1011690	A 96-Hour Toxiciety Test with the Freshwater Alga (Selenastrum capricornutum). 2002. Report Number 289A-152. DACO: 9.8.2
1011691	Alga, Growth Inhibition Test (72 [h]). 1998. Project Number 981001CL, Report Number 3011. DACO: 9.8.2
1011692	A 96-Hour Toxicity Test of Bardac 22C50 with Marine Diatom (Skeletonema costatum). 2004. Report Number 289A-161. DACO: 9.8.3
1011693	A 7-Day Toxicity Test of Bardac 22C50 with Duckweed (Lemna gibba G3). 2004. Report Number 289A-159. DACO: 9.8.5
1011823	A 96 Hour Toxicity test with the freshwater Algae (Selenastrum capricornutum) Using Natural Surface Water. 2003. Report Number 289A-153. DACO: 9.8.2

4.0 Value

PMRA Document Number	Reference
1011753	Efficacy of ACQ Wood Preservatives Formulated with Didecyl Dimethyl Ammonium Carbonate/Bicarbonate (Carboquat WP-50), DACO: 10.2.3.2
1011754	Fixation Mechanism for ACQ in Treated Wood; Deficiency Response Data., DACO: 10.2.1
1079436	Lonzagroup Technical Service Report. 2005. Report Number CS-05-006. DACO: 10.3
1094081	Evaluation of Copper Leachability in Southern Pine and Amabilis Fir Treated with NW 100. 2004. Project Number 3018. DACO: 8.3.4
1094082	Initiation of Ground Contact Field Test of Stakes Treated with ACQ-D (Carbonate). 2005. Project Number 4464. DACO: 10.2.3.4
1178174	DDA with Various Anions. Deficiency Response. 2003. DACO: 10.2.1,10.2.3.2,10.2.3.3
1178177	Proposal to P4 regarding re-wording, clarification, and standardization of the format of the definitions of ACQ Type C and ACQ Type D in AWPA Standard P5, and re-insertion of ACQ Type A into Standard P5. 2003. DACO: 10.6
1348666	Two-year inspection of an above-ground field test of lumber treated with ACQ-D(Carbonate). 2006. Project No. 5534. DACO: 10.2.3
1348667	One-year inspection of a ground contact field test of stakes treated with ACQ-D(Carbonate). 2006. Project No. 5501. DACO: 10.2.3
1345080	Two Year inspection of an above ground field test of lumber treated with ACQ -D (carbonate). 2006. Project Number 5534. DACO: 10.2.3.4
1346774	An Evaluation of the Efficacy of ACQ Type D In Canadian Wood Species Using the AWPA Standard E10 Soil Block Procedure. 2006. Report Number AQ P144. DACO: 10.2.3.2(G)
1346775	An Evaluation of the Efficacy of ACQ Type D In Canadian Wood Species Using the AWPA Standard E10 Soil Block Procedure - Methodology. 2006. Report Number AQ P144. DACO: 10.2.3.2(G)
1346777	An Evaluation of the Efficacy of ACQ Type D In Canadian Wood Species Using the AWPA Standard E10 Soil Block Procedure. 2006. Report Number AQ P144. DACO: 10.2.3.2(G)